KEEPING WARM ON MARS: STRATEGIES FOR MICROMISSION THERMAL DESIGN.

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This paper presents a simple, intuitive view of thermal designs for surviving the Martian surface, particularly at night, emphasizing the differences between earth, Mars, and space. Innovations are proposed to take best advantage of native resources.

On Mars, convective coupling to a body is at least 10 times smaller than on earth, and the air temperature (and wind velocity) may be correspondingly less important. In terms of convective losses, an evening at -78°C on Mars is equivalent to a brisk 12°C (54F) evening on earth relative to body temperature. Radiative losses at night will be approximately 50% greater than on earth (due to the colder sky), and are comparable to the convective losses. Unprotected on Mars, we would surely freeze to death from conductive losses across a 100°C temperature gradient, but our demise would be very slow compared to exposure to an Arctic winter.

The slow loss of heat from surfaces tempts us to use passive solar heating to the fullest. Simple greenhouses or more sophisticated "selective absorbers" provide half the thermal energy as they would on earth, more than sufficient to raise the daytime temperature of small payloads to well above room temperature.

The good thermal insulating properties of carbon dioxide, comparable to many of the preferred thermal foams, encourages the use of air gaps to replace heavy insulation. Dry martian soil should also be a good thermal insulator. On earth, there is a geometric limitation on the thickness of insulation, beyond which convective losses from the growing surface area exceed additional reduction in conduction. On Mars this limitation is relaxed, and a light-weight deployable wind-dome might provide effective night-time heat conservation